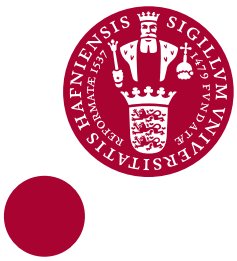

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Published in:
Journal of Archaeological Science: Reports

DOI:
10.1016/j.jasrep.2020.102361

Publication date:
2020

Document version
Publisher's PDF, also known as Version of record

Journal of Archaeological Science: Reports 31 (2020) 102361

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

Fragments of meals in eastern Denmark from the Viking Age to the Renaissance: New evidence from organic remains in latrines

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ARTICLE INFO

Keywords:
Plant remains
Pollen
Animal bones
Latrines
Food
Trade

ABSTRACT

A series of latrines from Denmark, spanning the periods Viking Age to Renaissance (800s–1680s AD), have been analysed for their contents of macroscopic plant remains, pollen, and animal bones. Here we present the results and discuss the findings in relation to ancient meals. The latrines cover a period of roughly 900 years, enabling us to trace the introduction of certain types of food and the disappearance of others over time. Some plant foods have been observed archaeologically for the first time in Denmark, including cucumber and rhubarb, while two other new plants from the assemblage, citrus and cloves, have previously been reported on. Our study shows how analyses of the different organic components in a latrine complement each other, leading to new information being gained on aspects of daily life such as diet, health and culinary practices.

1. Introduction

We present here the results from a study of latrines in Denmark dating from the Viking Age (800s AD) to the Renaissance (1680s AD). The contents of the latrines have been subjected to analysis on a series of organic remains: macroscopic plant remains, pollen, and animal bones. Together, the organic remains provide us with detailed insights into the ingredients that formed part of the diet of the users of the latrines. This is the first time a Danish latrine assemblage of this size and timespan has been analysed as a whole, enabling us to compare and interpret the dataset within a longer chronological framework than hitherto possible.

Latrines form an excellent source of ancient diet, but a full analysis of their organic contents is often neglected due to their obvious function when encountered in excavations (Smith, 2013). A survey of Viking Age and Medieval latrines excavated in Jutland (Keyes, 2009) has shown that out of 40 latrines, only 15 were sampled for archaeobotanical analysis, of which only two cases were actually analysed and, of those, one was published (Fruergaard and Moltsen, 2005). A few other Danish latrines, mainly from later periods and outside of Jutland, have also been published (Jørgensen, 1980, Jørgensen et al., 1986, Andersen and Moltsen, 2007, Ørnbjerg et al., 2016). Elsewhere in northern Europe, analysis of macroscopic plants from latrines remain the standard and has been carried out for the past many years with excellent results (e.g. Dennel, 1970, Greig, 1981, Hellwig, 1997, Märkle, 2005), and recently, pollen analysis has been shown to add considerably to the information gained from latrines (Deforce, 2017; Deforce et al., 2019). Our research, in this paper and elsewhere (Hald et al., 2018), shows how analyses of the different organic components in a latrine complement each other, leading to new information being gained on aspects of daily life such as diet, health and culinary practices.

Four of the latrines presented here were analysed within the past few years by several of the co-authors of this paper: pollen analysis by M.F. Mortensen, archaeozoological analysis by B. Magnussen and archaeobotanical analyses by M.M. Hald and P.S. Henriksen. The majority of the latrines, however, had until now only been analysed for their

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https://doi.org/10.1016/j.jasrep.2020.102361
Received 21 August 2019; Received in revised form 2 April 2020; Accepted 4 April 2020
Available online 27 April 2020

contents of macroscopic plant remains as part of the standard procedures within contract archaeology. Some of the latrines have been discussed briefly in the literature (e.g. Karg, 2007), but a full quantitative discussion and presentation had not been carried out until now. The results from the analyses highlight the huge research potential in being able to access, collate, and re-analyse the "grey literature" of contract archaeology and original samples in the museum archives.

2. Materials and methods

The material used in the present study was collected from 12 latrines from the islands of Zealand and Funen in eastern Denmark (Fig. 1 and Table 1).

Visual inspection in the field as well as detailed analysis of the contents of latrines has made it clear that the latrines in many, if not most, cases doubled as refuse bins during the time of their use. Also, some latrines were established from reused materials and features (barrels, bins), which could have contained refuse material from the beginning. Other latrines may have started off as such and were later infilled with household refuse. The two reused wells at Østergade and Adelgade were probably not used as latrines as such, but contained enough clearly identifiable fecal material to merit inclusion in the present study. Thus the gradient between fecal and refuse matter was not always obvious and a small proportion of the material discussed here may in fact be the latter, including, for instance, larger animal bones, as discussed below in Section 3.1.

As mentioned above, all latrine samples were originally collected for archaeobotanical analysis as part of procedures during rescue excavations, and the analyses of macrobotanical plant remains were carried out by several members of staff at the National Museum of Denmark over a number of years. For the present study, sub-samples were taken for the remaining types of analysis from leftover deposits stored at the National Museum. All latrines were analysed for their macroscopic

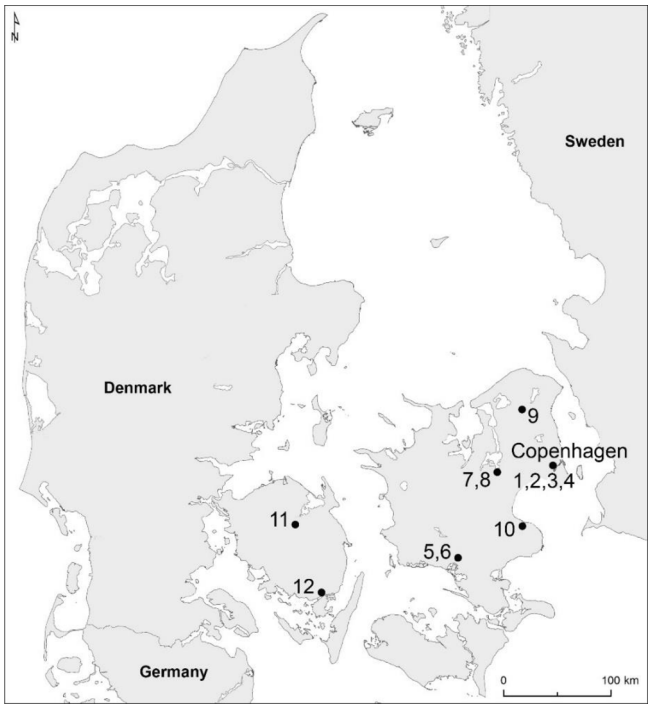

Fig. 1. Map of location of latrines used in the study. 1–4: Kultorvet, Adelgade 12, Højbro Plads A and B, Copenhagen; 5–6: Susåen and Lillelunds Have, Næstved; 7–8: Provstevænget and Skomagergade 19, Roskilde; 9: Østergade, Hillerød; 10: Toftegaard, Stevns; 11: Lotzes Have, Odense, and 12: Brogade, Svendborg.

Table 1
Date, location and context of the latrines used in the present study, and estimated social status of their immediate environments. Social status was determined by the excavators from the surroundings of the latrines, including associated buildings and objects. Age of latrines was determined either by dendrochronology of the latrine boxes/barrels or from the associated material culture.

Location of latrine	Museum reg. no.	Date (A.D.)	Construction of latrine	Context	General location	Social status	Reference
Toftegaard, Stevns	KØM 1699	Early Viking Age (775–970)	pit	within small pithouse	100 m from large Viking halls	high-status	Beck, 2013
Skomagergade 19, Roskilde	ROM 1828	EMA (1100s)	box made of oak planks	outside, in boundary ditch with runoff towards the street	middle of town on plot facing main street, probably densely occupied	probably middle class, craftspeople	Koch, 1998
Provstevænget, Roskilde	ROM 1351/90	EMA (12–1300)	pit	outside, but close to building	densely occupied living area	top status, dwelling for church elite	Andersen, 1997
Lillelunds Have, Næstved	NÆM 1993:800	EMA	barrel	backyard/garden	middle of town, close to main street	high-status	Langkilde, 2010
Højbro Plads A, Copenhagen	KBM 1213	LMA (1400s)	barrel	outside houses	town centre	unknown	Johansen, 1996, 1999
Susåen, Næstved	NÆM 1998:113	LMA (1400s)	barrel	by the harbour	middle of town	high-status	Petersen, 1987
Brogade, Svendborg	SOM148-92	LMA (c. 1500)	barrel	house in backyard	middle of town	high-status	Christensen, 1993a,b, Jansen 1999
Lotzes Have, Odense	OBM8204 (LH95)	LMA	box made of reused oak planks	backyard/garden	middle of town, 80 m from house	servants	Arentoft, 1996
Østergade, Hillerød	NFH A701	mid 1600s	reused well	prob. backyard	E part of town, in street lined with houses	unknown	Staal, 1998; Bayer, 1998
Kultorvet, Copenhagen	KBM 3959	1680s	reused wine barrels	backyard	town centre	middle class	Mosekilde, 2012
Adelgade 12, Copenhagen	KBM 3974	1680s	reused well	outside houses	neighbourhood in town	middle class to high-status	Simonsen, 2014
Højbro Plads B, Copenhagen	KBM 3934/3942	late 1600s-late1700s	brick-built latrine	inside house	town centre	middle class	Pedersen, 2012

Table 2
Types of analysis undertaken on each latrine. All previously analysed archaeobotanical data was retrieved from the archaeobotanical database at the National Museum of Denmark, and in the cases where data has been reported on elsewhere (primarily in unpublished technical reports), the references are listed here.

Location of latrine	Museum reg. no.	Macrobotanical remains	Pollen	Animal bones	Source of original archaeobotanical data
Toftegaard, Stevns	KØM 1699	X	X		Henriksen and Mortensen, in press
Skomagergade 19, Roskilde	ROM 1828	X	X	X	Robinson et al., 2002
Provstevænget, Roskilde	ROM 1351/90	X			Robinson and Harild, 1996a
Lillelunds Have, Næstved	NÆM 1993:800	X			National Museum database
Højbro Plads A, Copenhagen	KBM 1213	X	X	X	National Museum database
Susåen, Næstved	NÆM 1998:113	X			National Museum database
Brogade, Svendborg	SOM148-92	X	X	X	National Museum database
Lotzes Have, Odense	OBM8204(LH95)	X			Robinson and Harild, 1996b
Østergade, Hillerød	NFH A701	X	X		National Museum database; Karg, 2007
Kultorvet, Copenhagen	KBM 3959	X	X	X	Hald 2015; Hald et al., 2018
Adelgade 12, Copenhagen	KBM 3974	X			Bennike and Hald, 2015
Højbro Plads B, Copenhagen	KBM 3934/3942	X			Hald, 2012

plant remains, six latrines were analysed for their pollen contents, and archaeozoological analysis was undertaken on four of the latrines. The variation in numbers of analyses undertaken was due to the fact that some of the original archaeobotanical samples were either too small for archaeozoological analysis, which necessitates a relatively large sample size of 5–10 l, or the samples had been used up altogether in the course of the initial archaeobotanical analysis. Pollen analysis was carried out on all samples where material was still left. Table 2 presents the types of analysis undertaken for each latrine. The contents of one latrine, from Kultorvet in Copenhagen, have been published separately (Hald et al., 2018) and are included here for comparison. All analyses were carried out following standard methods as described in Hald et al., (2018:604-5): archaeobotanical samples were wet-sieved in sieves of minimum 300 μm mesh size and plant remains identified with a binocular microscope with magnifications of up to 100x; pollen samples were processed by standard methods following Fægri and Iversen (1989) and pollen was identified using light microscopy with magnification up to 1000x; archaeozoological samples were wet-sieved in sieves of minimum 0.5 mm mesh size and bones identified using a stereomicroscope with magnification up to 50x. The Østergade latrine was analysed for animal bones in a previous study (Rosenlund, 1999) and included here for comparison.

3. Results

Our results from the three types of analysis – grains/seeds, pollen, animal bones – are presented below within the two categories of food remains and non-food remains, respectively. “Food” is used here as a short-hand for any consumable goods intended for eating, drinking or inhaling. This includes “core components” of meals such as cereal grains and meat, as well as flavour-providing herbs, spices and condiments, medicinal plants, and plants used for recreational purposes. We have also included plants that are more usually considered weeds or wild taxa, but which we believe arrived in the latrines as food remains, such as, for instance, remains of honey. Some plants served more than one purpose and for the medicinal plants especially, the identification of these taxa as either food or medicine is not always obvious. In the non-food category of plants, the grouping is also quite tentative: we have attempted to distinguish between field weeds and other wild taxa, for instance, as this relates to modes of transportation of the plant remains (i.e. the arrival of plants together with a harvested crop, or randomly blown in from nearby trees). Many of the plants on our lists could quite easily be placed in several of the groups, but here we have attempted to define the most likely group for each plant species, based on habitat information in Mossberg and Stenberg (2005).

The identified plant remains are presented in Table 3 (grains/seeds) and 4 (pollen), while the identified animal bones are presented in Table 4.

3.1. Food remains

A substantial part of the plant remains in the latrine derives from the consumption of food. While some of these food plants undoubtedly derived from fecal material, others are more likely to be derived from refuse material. This latter group includes remains such as hazelnut shells and flax capsules, which were unlikely to have been eaten, at least deliberately. However, we believe they still reflect consumption patterns and they are therefore included in the food remain group. Some of the plants that we have listed as food are mainly being considered as weeds today, such as for instance ground elder (*Aegopodium podagraria*) and the large group of Brassicaceae, which include both definite food plants such as mustard (*Brassica nigra*) as well as wild insect-pollinated plants that are very likely to have arrived in the latrines as remains of honey (Deforce, 2010).

Fig. 2 presents the remains of crops and other culinary plants that were observed; the presence of grains/seeds and pollen, respectively, are marked for each latrine, which are listed chronologically. The food plants are ranked according to their frequency, i.e. the percentage of total number of latrines that each food plant is present in. Presence/absence as well as frequency, rather than absolute numbers as presented in Table 3 and Supplementary table, provide a better reflection of the consistency (or lack thereof) of a food plant through time, as single-event large concentrations of seeds will then not create a bias towards one particular crop at the expense of more stable crops present in lower concentrations. One example is fig, *Ficus carica*, which is the food plant with the most seeds (no: 483; Table 3) found by far in the assemblage, but which is only recorded from two latrines. Each fig fruit contains hundreds of seeds, and while it is the most common food plant in the assemblage based on seed quantity, we may in fact be looking at the remains of two fig fruits only.

Looking at Fig. 2, Brassicaceae seeds are the most frequent representatives of all food plants in the latrines, absent only from Viking Age Toftegaard, though here it is present as Brassicaceae pollen. Cereal remains, primarily represented by bran and pollen but also some grains (noted separately when identified

to species in Fig. 2) are also very common in the latrines, followed by flax (*Linum usitatissimum*) and elder (*Sambucus nigra*) seeds present in more than 60% of the latrines. Hops (*Humulus lupulus*), strawberry (*Fragaria vesca*), mint (*Mentha* sp.), and dill (*Anethum graveolens*), are present in more than 50% of the latrines, predominantly as seeds.

A further range of food plants are present in fewer latrines, mostly from the Late- and Post-Medieval periods. These include fruit and vegetables such as plum (*Prunus* sp.), apple (*Malus* sp.), raspberry (*Rubus idaeus*), blackcurrant (*Ribes nigrum*), fig (*Ficus carica*), cucumber (*Cucumis sativa*), rhubarb (*Rheum* sp.) and grape (*Vitis vinifera*), and herbs and spices such as ground elder (*Aegopodium podagraria*), mustard (*Sinapis* sp.), coriander (*Coriandrum sativum*), citrus (*Citrus* sp.) and cloves (Myrtaceae). Plants that may have been used medicinally or for

Table 3
Macroscopic plant remains from the latrines presented in this paper, represented by grains/seeds/fruit unless otherwise stated. All remains are waterlogged. The plant remains are divided into groups of most likely function or habitat (based on Mossberg and Stenberg, 2005) and listed alphabetically in each group.

Site name	Toftegård (775–970)	Skomagergade 19 (1100s)			Provstevænget (12–1300)	Lillelunds Have (EMA)		Højbro Plads A (1400s)				Susåen (1400s)	
Sample number	A-31003	BK 25	BL 53	BL 55	TK23	EB	EX	41	44	46	47	100	101
Food plants													
Aegopodium podagraria													
cf. *Aegopodium podragraria*													
Anethum graveolens										1			
cf. *Anethum graveolens*					1								
Anthriscus cf. *cerefolium*													
Anthriscus cf. *sylvestris*												1	2
Avena sativa, grain													
Avena sp.													
Avena sp., bran													
Avena sp., flower base		1											
Barbarea sp.													
Brassica nigra						1							
Brassica cf. *nigra*													
Brassica sp.													
Brassica sp./*Sinapis* sp.													
Brassicaceae		3							2	2			
cf. Brassicaceae					1							7	
Bromus sp./Cerealia													
Cannabis sativa													3
Cerealia, chaff								35	4	4	6	20	3
Cerealia, grain		5			3			1	1		1	1	
cf. Cerealia, grain													1
Cerealia, straw												2	
Cerealia, bran													
Coriandrum sativum													
Corylus avellana, shell fragment		3						25	15	6	3	8	
Fagopyrum esculentum													
Ficus carica													
Fragaria vesca													
Fragaria cf. *vesca*													
cf. *Fragaria vesca*							1						
Fragaria viridis													
Fragaria sp./*Potentilla* sp.	2												1
Fragaria sp.													1
cf. *Fragaria* sp.												3	
Hordeum vulgare, six-row, grain	1												
Hordeum vulgare, six-row, chaff													
Hordeum vulgare, grain													
Hordeum sp., bran													
Humulus lupulus		1						1	3	1	1	46	15
cf. *Humulus lupulus*													
Hyoscyamus niger							2					1	
Hypericum cf. *perforatum*													
Hypericum maculatum								1					
Lactuca sp.													
Linum catharticum					1			4	2	1	2		
Linum usitatissimum, seed		2			4			1	2	3			
Linum usitatissimum, capsule fragment		5	3		20			2		1			5

(*continued on next page*)

Table 3 (*continued*)

Site name	Toftegård (775–970)	Skomagergade 19 (1100s)			Provstevænget (12–1300)	Lillelunds Have (EMA)		Højbro Plads A (1400s)				Susåen (1400s)	
Sample number	A-31003	BK 25	BL 53	BL 55	TK23	EB	EX	41	44	46	47	100	101
Malus domestica													
Malus sp., core fragment													
cf. *Malus* sp.													
Malus/Pyrus sp.													
Mentha aquatica/arvensis				6									
Mentha arvensis													
Mentha sp.	2					1		1					
Myrica gale, seed		5						2	4	1		2	
Myrica gale, twig								11	6			3	
Myrica gale, leaf fragment		2						18	2			21	
Myrica gale, catkin									1				
Nicotiana rustica													
Papaver cf. *somniferum*													
Papaver somniferum												3	2
Pastinaca sativa													
Prunus avium													
Prunus domestica ssp. *insititia*													
Prunus sp.								1					
cf. *Prunus* sp.		1											
Ribes nigrum													
Rubus caesius								13					
Rubus idaeus												12	1
Rubus idaes/caesius													
Rubus fruticosus													
Rubus sp.	1		1										
Sambucus nigra							4					2	7
Sambucus cf. *nigra*													
Sambucus sp.		1	2			2		1					
cf. *Sambucus* sp.													
Secale cereale, grain													
Secale cereale, chaff		3											
Sinapis arvensis													
cf. *Sinapis arvensis*													
Tripleurospermum inodorum		1											
Triticum sp., grain	1												
Vaccinium sp.													
Vicia sp.													
Vitis vinifera, pip													
Vitis vinifera, fruit													
Field weeds													
Achillea millefolium		2											
Achillea cf. *millefolium*												1	
Agrostemma githago	1	28	1		3			20	10		5	26	6
Agrostis sp.					1								
Anthemis arvensis													
Anthemis cf. *arvensis*													
Anthemis cf. *tinctoria*													
Anthemis cotula													
Anthemis sp.								4	2	1	2		
Brassica rapa ssp. *campestris*													
Carduus sp.								1					
Carduus/Cirsium		2	3										

(*continued on next page*)

Table 3 (*continued*)

Site name	Toftegård (775–970)	Skomagergade 19 (1100s)			Provstevænget (12–1300)	Lillelunds Have (EMA)		Højbro Plads A (1400s)				Susåen (1400s)	
Sample number	A-31003	BK 25	BL 53	BL 55	TK23	EB	EX	41	44	46	47	100	101
Centaurea cyanus					1								
Centaurea sp.										1			
Cerastium fontanum ssp. *vulgare* var. *holosteoides*								11					
Cerastium sp./*Stellaria* sp.													
Cerastium sp.													
Chenopodium album		26	22		10		34	11	13	2	3	68	92
Chenopodium botryodes/rubrum													
Chenopodium cf. *rubrum*										1			
Chenopodium glaucum/rubrum/botryodes		3											
Chenopodium hybridum													
Chenopodium murale													
Chenopodium polyspermum													
Chenopodium urbicum													
Chenopodium sp.	118	10	13	50	6								
Chenopodiaceae		8	16										
Cichorium intybus					1								
Cichorium cf. *intybus*													
Fabaceae													
Fabaceae, leaf fragments		4											
Fallopia convolvulus	1					2						1	
Fallopia convolvulus/Polygonum aviculare		4	2					4	2	1	2	2	1
Neslia paniculata, seed							1						
Neslia paniculata, capsule fragment			4			1		7				27	25
Papaver argemone												2	
Papaver cf. *argemone*													
Papaver dubium/rhoeas							9						
Persicaria cf. *maculosa*													
Persicaria hydropiper		2											
Persicaria laphatifolia												2	1
Persicaria maculosa												1	3
Persicaria maculosa/lapathifolium	2	2				2		3	3	1	1	1	
Persicaria minor								7	1	1			
Persicaria sp.													
Poa annua													
Poa sp.						2							
Poaceae	3	15			4		2	14	7	4	3	45	7
Poaceae, chaff frag													
Polygonum aviculare	13	2			2								
Polygonum cf. *aviculare*													
Polygonum sp.													2
Polygonaceae													
Prunella vulgaris								3	3	1	3		1
Spergula arvensis		1								1		11	1
Stellaria graminea					2								
Stellaria graminea/palustris													2
Stellaria holostea									4		2		
Stellaria media		17	1		3		1					87	73

(*continued on next page*)

Table 3 (*continued*)

Site name	Toftegård (775–970)	Skomagergade 19 (1100s)			Provstevænget (12–1300)	Lillelunds Have (EMA)		Højbro Plads A (1400s)				Susåen (1400s)	
Sample number	A-31003	BK 25	BL 53	BL 55	TK23	EB	EX	41	44	46	47	100	101
Stellaria palustris							1						
Stellaria sp.													
Taraxacum sp.													
Thlaspi arvense	1	2	1		5	4	2	3	2		1	6	5
Trifolium sp.	1												
cf. *Verbascum* sp.		1											
Veronica arvensis	5												
Viola arvensis/tricolor	2												
Ruderals													
Aethusa cynapium		2				2						3	5
cf. *Aethusa cynapium*							4						
Alisma plantago-aquatica			1									1	
cf. *Anchusa* sp.					2								
Angelica sylvestris													1
Aphanes arvensis		4						1				3	1
cf. Asteraceae													
Capsella bursa-pastoris	3												
Carex sp.		2		4	33	10	10	13	4	5	3		
Carex sp., perigynium													
Caryophyllaceae				15	1							17	
Chrysanthemum segetum									1				
Descurainia sophia													1
Dianthus deltoides									1				
Eleocharis palustris/uniglumis	1												
Eleocharis sp.												8	7
Epilobium sp.		1											
Equisetum sp., rootstock													3
cf. *Eupatorium cannabinum*													
Euphorbia helioscopia			1						1			6	1
Euphrasia sp./*Odontites* sp.		1											
Filipendula ulmaria											2		
Fumaria officinalis													
Glebionis segetum													
Galium spurium													
Galium sp.													
Hieracium umbellatum								1					
cf. *Leucanthemum vulgare*					2								
cf. *Moehringia trinervia*					1								
cf. *Sisymbrium officinale*								3					
Solanum dulcamara													1
Solanum nigrum		6				5	1		1				11
Sonchus arvensis													
Sonchus asper		1											
Sonchus cf. *arvensis/oleraceus*													
Sonchus oleraceus												1	1
Sonchus palustris								1					
Urtica dioica		11	4		2							100	662
Urtica urens		51	1					1		1		62	36
Urtica sp.													
Veronica chamaedrys/ serpyllifolia													
Veronica sp.													

(*continued on next page*)

Table 3 (*continued*)

Site name	Toftegård (775–970)	Skomagergade 19 (1100s)			Provstevænget (12–1300)	Lillelunds Have (EMA)		Højbro Plads A (1400s)				Susåen (1400s)	
Sample number	A-31003	BK 25	BL 53	BL 55	TK23	EB	EX	41	44	46	47	100	101
Viola cf. *arvensi*													
Viola cf. *riviniana*													
Viola sp.				1		1						1	
Viola sp., capsule fragment													
cf. *Viola* sp.		1											
Wild taxa													
Apiaceae		1	2									2	
Arctium sp.													
Artemisia vulgaris													
Asteraceae		1				1						2	3
Atriplex cf. *prostrata*					1								
Atriplex sp.		2			2								
Cakile maritima													
Cirsium sp.					3								
Cyperaceae		1	1									58	42
Galeopsis sp.		3	4	5					1				
Galeopsis speciosa												1	
Hypochoeris radicata													
Juncus sp.													
Lamiaceae													
Lamium cf. *purpureum* ssp. *purpureum*													
Lamium sp.	2	1				3							3
Lapsana communis										1			
Leontodon autumnalis								4	1				
Leontodon cf. *autumnalis*					1								
Leontodon hispidus													
Leontodon sp.												2	
Leucanthemum vulgare													
Luzula sp.	1											1	1
Lychnis flos-cuculi												1	
Lycopus europaeus													1
Malva sylvestris									1				
Malva sp.													1
Menyanthes trifoliata		1								1			
Myosotis sp.	2				1			2		1			
cf. *Myosotis* sp.												2	
Najas flexilis	7												
Pedicularis palustris													
Plantago major	1		1						3				
Plantago sp.						1							
Potentilla anserina				1								2	
Potentilla erecta									6			2	
Potentilla cf. *erecta*													
Potentilla sp.			1					20		2	3	2	3
Primulaceae													
Ranunculus flammula									2				
Ranunculus cf. *flammula*													
Ranunculus repens					2								
Ranunculus cf. *repens*													
Ranunculus sceleratus		2	1					68	17	2			6
Ranunculus sp.			1		2			4	3	3	3	6	6

(*continued on next page*)

Table 3 (*continued*)

Site name	Toftegård (775–970)	Skomagergade 19 (1100s)			Provstevænget (12–1300)	Lillelunds Have (EMA)		Højbro Plads A (1400s)				Susåen (1400s)	
Sample number	A-31003	BK 25	BL 53	BL 55	TK23	EB	EX	41	44	46	47	100	101
Raphanus raphanistrum, seed													
Raphanus raphanistrum, capsule		1											
Raphanus raphanistrum, capsule fragment		5	11		96	1		7	3	3	3	55	23
Raphanus raphanistrum, spikelet base													
cf. *Raphanus raphanistrum*			1										
Rhinanthus sp.											3		
Rumex acetosella	10	8	1		2	1		15	12	3	2	3	4
Rumex cf. *crispus*, leaf													
Rumex cf. *hydrolapathum*													
Rumex sp., seed		2		14	1			3	1			3	2
Rumex sp., perianth fragment												4	
Rumex sp., leaf													
Rumex sp., leaf fragments													
Ruppia maritima													
cf. *Scabiosa* sp.													
Scirpus sylvaticus													
Scirpus sp.								6	4	3	5		
Scleranthus annuus L., calyx													1
Scleranthus annuus, calyx fragment											1		
Scleranthus sp., calyx												1	
Scleranthus sp., calyx fragment		2											
Setaria sp.							1						
Silene noctiflora							1						
Stachys palustris					1								
Suaeda maritima													
Triglochin maritima													
Typha latifolia													
Typha sp.													
Apium graveolens						1							
Batrachium sp.												2	
Caltha palustris					1								
Mosses and heath plants													
Bryophyta, leaf fragment													
Bryophyta, shoot fragment		56	3		1							55	3
Calluna vulgaris, flower											1		
Calluna vulgaris, twig								1					
Trees													
Alnus sp.													5
Betula sp.													
Juniperus communis, leaf													
Juniperus communis, twig													
Other													
Indeterminate	12												38

(*continued on next page*)

Table 3 (*continued*)

Site name	Brogade (c. 1500)					Lotzes Have (LMA)				Østergade (mid 1600s)		Kultorvet (1680s)		Adelgade 12 (1680s)	Højbro Plads B (late 1600–late 1700s)	TOTALS
Sample number	0–10 cm	10–20 cm	20–30 cm	30–40 cm	40–50cm	DRI	DRII	X475	X476	1	2	PM 1176	PM 1177	PM 10531	P98, A495	
Food plants																
Aegopodium podagraria						1						1				2
cf. *Aegopodium podragraria*															15	15
Anethum graveolens		1			1	1	1					7				12
cf. *Anethum graveolens*																1
Anthriscus cf. *cerefolium*										1						1
Anthriscus cf. *sylvestris*																3
Avena sativa, grain												3				3
Avena sp.								3								3
Avena sp., bran												x				0
Avena sp., flower base																1
Barbarea sp.										2	1					3
Brassica nigra								2				17	3	13		36
Brassica cf. *nigra*	1															1
Brassica sp.	2		1					3							25	31
Brassica sp./*Sinapis* sp.										12		2				14
Brassicaceae	1				2	2	2	69	1	39	2					125
cf. Brassicaceae										11						19
Bromus sp./Cerealia								2								2
Cannabis sativa																3
Cerealia, chaff			2		9									5		88
Cerealia, grain	1		8		9	3	1	14	1	50	6			5	2	112
cf. Cerealia, grain																1
Cerealia, straw																2
Cerealia, bran												a lot				a lot
Coriandrum sativum												1				1
Corylus avellana, shell fragment						3	1						2			66
Fagopyrum esculentum	1			1	2	8		5	1	2	1	16				37
Ficus carica												250	45		188	483
Fragaria vesca												2	6		58	66
Fragaria cf. *vesca*						1										1
cf. *Fragaria vesca*																1
Fragaria viridis												2				2
Fragaria sp./*Potentilla* sp.																3
Fragaria sp.																1
cf. *Fragaria* sp.											1					4
Hordeum vulgare, six-row, grain								16								17
Hordeum vulgare, six-row, chaff						3			2							5
Hordeum vulgare, grain															1	1
Hordeum sp., bran												a lot				a lot
Humulus lupulus	6		6		3	1	1	3		31	2	7	3			131
cf. *Humulus lupulus*											3					3
Hyoscyamus niger		1		1		1						1				7
Hypericum cf. *perforatum*						2										2
Hypericum maculatum																1
Lactuca sp.												1				1
Linum catharticum								2								12
Linum usitatissimum, seed					1			1		8	1	3				26
Linum usitatissimum, capsule fragment								14								50
Malus domestica												16	2		2	20

(*continued on next page*)

Table 3 (*continued*)

Site name	Brogade (c. 1500)					Lotzes Have (LMA)				Østergade (mid 1600s)		Kultorvet (1680s)		Adelgade 12 (1680s)	Højbro Plads B (late 1600–late 1700s)	TOTALS
Sample number	0–10 cm	10–20 cm	20–30 cm	30–40 cm	40–50cm	DRI	DRII	X475	X476	1	2	PM 1176	PM 1177	PM 10531	P98, A495	
Malus sp., core fragment					1											1
cf. *Malus* sp.								1								1
Malus/Pyrus sp.												2			3	5
Mentha aquatica/arvensis																6
Mentha arvensis			1			1		1								3
Mentha sp.																4
Myrica gale, seed								1								15
Myrica gale, twig																20
Myrica gale, leaf fragment																43
Myrica gale, catkin																1
Nicotiana rustica										1						1
Papaver cf. *somniferum*						1			1							2
Papaver somniferum					4						1					10
Pastinaca sativa														7		7
Prunus avium												2	2			4
Prunus domestica ssp. *insititia*												8	1	10		19
Prunus sp.					1											2
cf. *Prunus* sp.																1
Ribes nigrum												2				2
Rubus caesius																13
Rubus idaeus											1	3				17
Rubus idaes/caesius													1	1		2
Rubus fruticosus												1				1
Rubus sp.																2
Sambucus nigra												4				17
Sambucus cf. *nigra*					1											1
Sambucus sp.						3	3	2	4							18
cf. *Sambucus* sp.											1					1
Secale cereale, grain								8				1		1		10
Secale cereale, chaff	3							218	2							226
Sinapis arvensis												3				3
cf. *Sinapis arvensis*								4								4
Tripleurospermum inodorum										2						3
Triticum sp., grain																1
Vaccinium sp.											3					3
Vicia sp.												1				1
Vitis vinifera, pip												5	1		10	16
Vitis vinifera, fruit												1				1
Field weeds																
Achillea millefolium																2
Achillea cf. *millefolium*																1
Agrostemma githago	6		6		7	9	2	19	3	56	5	lots	1	lots	1	215
Agrostis sp.																1
Anthemis arvensis								1								1
Anthemis cf. *arvensis*						1										1
Anthemis cf. *tinctoria*							1									1
Anthemis cotula			2		1											3
Anthemis sp.										1						10
Brassica rapa ssp. *campestris*												1				1
Carduus sp.																1

(*continued on next page*)

Table 3 (*continued*)

Site name	Brogade (c. 1500)					Lotzes Have (LMA)				Østergade (mid 1600s)		Kultorvet (1680s)		Adelgade 12 (1680s)	Højbro Plads B (late 1600–late 1700s)	TOTALS
Sample number	0–10 cm	10–20 cm	20–30 cm	30–40 cm	40–50cm	DRI	DRII	X475	X476	1	2	PM 1176	PM 1177	PM 10531	P98, A495	
Carduus/Cirsium									2							7
Centaurea cyanus	2		1		3	2		5		9						23
Centaurea sp.												5	4	4		14
Cerastium fontanum ssp. *vulgare* var. *holosteoides*																11
Cerastium sp./*Stellaria* sp.											1					1
Cerastium sp.	1															1
Chenopodium album	9		9		4	1	2	14	5	15	17	68	15	29	11	480
Chenopodium botryodes/rubrum							22									22
Chenopodium cf. *rubrum*																1
Chenopodium glaucum/rubrum/botryodes																3
Chenopodium hybridum							1		1							2
Chenopodium murale						1										1
Chenopodium polyspermum						2	5									7
Chenopodium urbicum			1		1											2
Chenopodium sp.							7	27	3							234
Chenopodiaceae																24
Cichorium intybus								2								3
Cichorium cf. *intybus*											1					1
Fabaceae						1										1
Fabaceae, leaf fragments								41								45
Fallopia convolvulus										3		5				12
Fallopia convolvulus/Polygonum aviculare	1		5		2	1		14		8	7					56
Neslia paniculata, seed			1		1	1										4
Neslia paniculata, capsule fragment								14		4	1					83
Papaver argemone						1		14		1	2					20
Papaver cf. *argemone*					1											1
Papaver dubium/rhoeas																9
Persicaria cf. *maculosa*										1						1
Persicaria hydropiper					1											3
Persicaria laphatifolia	5					2		32		24	2	11	1			80
Persicaria maculosa								10		1	1					16
Persicaria maculosa/lapathifolium			6		5			30	2		2					60
Persicaria minor																9
Persicaria sp.															5	5
Poa annua					17				5						1	23
Poa sp.						17	6		3							28
Poaceae	4	1	22					20		6	9					166
Poaceae, chaff frag										79	12					91
Polygonum aviculare						6		3		2		1				29
Polygonum cf. *aviculare*													4			4
Polygonum sp.												1			3	6
Polygonaceae							1	50	2							53
Prunella vulgaris					1	1		8	1	4	1					27
Spergula arvensis	1		3		1			8	2	6	1					36
Stellaria graminea																2
Stellaria graminea/palustris										2	1					5
Stellaria holostea																6
Stellaria media	3		2		6	1	2	7	3	4	5	9	6	1		231

(*continued on next page*)

Table 3 (*continued*)

Site name	Brogade (c. 1500)					Lotzes Have (LMA)				Østergade (mid 1600s)		Kultorvet (1680s)		Adelgade 12 (1680s)	Højbro Plads B (late 1600–late 1700s)	TOTALS
Sample number	0–10 cm	10–20 cm	20–30 cm	30–40 cm	40–50cm	DRI	DRII	X475	X476	1	2	PM 1176	PM 1177	PM 10531	P98, A495	
Stellaria palustris								1								2
Stellaria sp.										1						1
Taraxacum sp.					1	1	4									6
Thlaspi arvense	3		2		4			9	4	8	1	1	1		3	68
Trifolium sp.																1
cf. *Verbascum* sp.																1
Veronica arvensis																5
Viola arvensis/tricolor																2
Ruderals																
Aethusa cynapium				1			2									15
cf. *Aethusa cynapium*																4
Alisma plantago-aquatica																2
cf. *Anchusa* sp.																2
Angelica sylvestris																1
Aphanes arvensis																9
cf. Asteraceae										3						3
Capsella bursa-pastoris										1						4
Carex sp.	2		1									9	5	3		104
Carex sp., perigynium											1					1
Caryophyllaceae								4		1						38
Chrysanthemum segetum																1
Descurainia sophia																1
Dianthus deltoides																1
Eleocharis palustris/uniglumis																1
Eleocharis sp.																15
Epilobium sp.		1														2
Equisetum sp., rootstock																3
cf. *Eupatorium cannabinum*							1									1
Euphorbia helioscopia										1						10
Euphrasia sp./*Odontites* sp.																1
Filipendula ulmaria								3								5
Fumaria officinalis										1			1			2
Glebionis segetum												1				1
Galium spurium												1				1
Galium sp.						1										1
Hieracium umbellatum																1
cf. *Leucanthemum vulgare*																2
cf. *Moehringia trinervia*																1
cf. *Sisymbrium officinale*																3
Solanum dulcamara																1
Solanum nigrum				1		3	5	1								34
Sonchus arvensis							42									42
Sonchus asper							4	4	2	2						13
Sonchus cf. *arvensis/oleraceus*						2										2
Sonchus oleraceus		1		1												4
Sonchus palustris																1
Urtica dioica	10		17	0	9	11	7		14	7	57				1	912
Urtica urens			1				2		1	3	2	2				163
Urtica sp.															3	3

(*continued on next page*)

Table 3 (*continued*)

Site name	Brogade (c. 1500)					Lotzes Have (LMA)				Østergade (mid 1600s)		Kultorvet (1680s)		Adelgade 12 (1680s)	Højbro Plads B (late 1600–late 1700s)	TOTALS
Sample number	0–10 cm	10–20 cm	20–30 cm	30–40 cm	40–50cm	DRI	DRII	X475	X476	1	2	PM 1176	PM 1177	PM 10531	P98, A495	
Veronica chamaedrys/ serpyllifolia										1						1
Veronica sp.					1											1
Viola cf. *arvensi*									1							1
Viola cf. *riviniana*											1					1
Viola sp.								3	2							8
Viola sp., capsule fragment								12								12
cf. *Viola* sp.																1
Wild taxa																
Apiaceae	1		1	1	1	1				1	3					14
Arctium sp.							1									1
Artemisia vulgaris				1												1
Asteraceae					1	2		4			2					16
Atriplex cf. *prostrata*																1
Atriplex sp.		1					3	3								11
Cakile maritima														1		1
Cirsium sp.						2	1	8								14
Cyperaceae				1	1	20	3	191	1	32	17					368
Galeopsis sp.	1		1					19	2	6						42
Galeopsis speciosa								1								2
Hypochoeris radicata			1													1
Juncus sp.										3	7		1			11
Lamiaceae								1	1							2
Lamium cf. *purpureum* ssp. *purpureum*											1					1
Lamium sp.								1	2							12
Lapsana communis		1			1											3
Leontodon autumnalis		1		1												7
Leontodon cf. *autumnalis*																1
Leontodon hispidus								4								4
Leontodon sp.										1	2					5
Leucanthemum vulgare								2		2						4
Luzula sp.								4								7
Lychnis flos-cuculi								1			1					3
Lycopus europaeus																1
Malva sylvestris													1			2
Malva sp.																1
Menyanthes trifoliata						1										3
Myosotis sp.																6
cf. *Myosotis* sp.																2
Najas flexilis																7
Pedicularis palustris								2								2
Plantago major					8		2	10		2	3					30
Plantago sp.																1
Potentilla anserina																3
Potentilla erecta										5	2					15
Potentilla cf. *erecta*								2								2
Potentilla sp.						2		5				8	2			48
Primulaceae									1							1
Ranunculus flammula						1	1									4

(*continued on next page*)

Table 3 (*continued*)

Site name	Brogade (c. 1500)					Lotzes Have (LMA)				Østergade (mid 1600s)		Kultorvet (1680s)		Adelgade 12 (1680s)	Højbro Plads B (late 1600–late 1700s)	TOTALS
Sample number	0–10 cm	10–20 cm	20–30 cm	30–40 cm	40–50cm	DRI	DRII	X475	X476	1	2	PM 1176	PM 1177	PM 10531	P98, A495	
Ranunculus cf. *flammula*								4								4
Ranunculus repens							1	4	2							9
Ranunculus cf. *repens*										1						1
Ranunculus sceleratus	1						1	1								99
Ranunculus sp.						2		2				1	1			34
Raphanus raphanistrum, seed	2		1		2	1		11	3			6				26
Raphanus raphanistrum, capsule												1		2		4
Raphanus raphanistrum, capsule fragment	14		10		6	13		370	7	300	15					942
Raphanus raphanistrum, spikelet base							1									1
cf. *Raphanus raphanistrum*																1
Rhinanthus sp.								3								6
Rumex acetosella			2		2	4		22		10	4	1				106
Rumex cf. *crispus*, leaf										1						1
Rumex cf. *hydrolapathum*											1					1
Rumex sp., seed	1	8		1				9		2	14		1			62
Rumex sp., perianth fragment																4
Rumex sp., leaf											4					4
Rumex sp., leaf fragments	3		2													5
Ruppia maritima			1													1
cf. *Scabiosa* sp.										1						1
Scirpus sylvaticus								1			4					5
Scirpus sp.			1													19
Scleranthus annuus L., calyx						2		3		1	1					8
Scleranthus annuus, calyx fragment																1
Scleranthus sp., calyx																1
Scleranthus sp., calyx fragment																2
Setaria sp.																1
Silene noctiflora																1
Stachys palustris																1
Suaeda maritima				1												1
Triglochin maritima						2										2
Typha latifolia																0
Typha sp.										1						1
Apium graveolens																1
Batrachium sp.																2
Caltha palustris																1
Mosses and heath plants																
Bryophyta, leaf fragment	27		90		365							lots	lots			482
Bryophyta, shoot fragment										200	52					370
Calluna vulgaris, flower																1
Calluna vulgaris, twig																1
Trees																
Alnus sp.										2	7					14
Betula sp.	1									3						4
Juniperus communis, leaf										7	1					8
Juniperus communis, twig										2						2
Other																
Indeterminate														5	2	57

Table 4
Animal bones identified in the latrines, calculated as NISP (i.e. Number of Individual Specimens).

Scientific name	Common name	Skomagergade	Højbro A	Brogade	Østergade	Kultorvet
Date of latrine (AD)		1100s	1400s	1500	1600s	1680s
Pisces	**Fish**					
Clupea harengus	Atlantic herring		51	1	3	27
Cyprinidae	Cyprinids				35	1
Anguilla anguilla	Eel					10
Gadus morhua	Cod		24		4324	1
Melanogrammus aeglefinus	Haddock		3		2	
Pollachius virens	Saith				4	
Molva molva	Ling				78	
Brosme brosme	Cusk				11	
Gadidae	Gadids/Cod fish		80	2	4000	3
Perca fluviatilis	Perch				6	1
Scomber scombrus	Mackerel				9	
Pleuronectes platessa	Plaice		1			
Pleuronectes platessa/Platichthys flesus/Limanda limanda	Plaice/flounder/dab		6			
Pleuronectidae	Flatfish				10	
Pisces unspec.	Fish unspec.		367	5		103
	Total fish		**532**	**8**	**8482**	**146**
Aves	**Birds**					
Anser anser/A. domesticus	Greylag goose/domestic goose				6	
Columba livia/C. domestica	Pigeon				1	
Aves unspec.	Birds unspec.		1			1
	Total birds		**1**		**7**	**1**
Mammalia	**Mammals**					
Canis familiaris	Dog		47			
Felis catus	Cat		29			1
Sus domesticus	Pig		2		10	1
Bos taurus	Cattle				16	
Ovis aries	Sheep				5	
Ovis aries/Capra hircus	Sheep/goat		1			
Mammalia unspec.	Mammals unspec.	4	8	3	37	9
	Total mammals	**4**	**88**	**3**	**68**	**11**
	Unspecified					
	Unspecified material					4
	Total	**4**	**621**	**11**	**8557**	**162**

recreation include St. John's-wort (*Hypericum* sp.), hemp (*Cannabis sativa*), hen-bane (*Hyoscyamus niger*) and tobacco (*Nicotiana rustica*). The beer additive bog myrtle (*Myrica gale*) is also present in less than 50% of the latrines, but unlike the group of plants listed above, it is only present in the earlier latrines, spanning the Early and Late Medieval periods.

Fig. 3. presents five of the most unusual species found as pollen, which each merit a short introduction. Four of the five food plants have

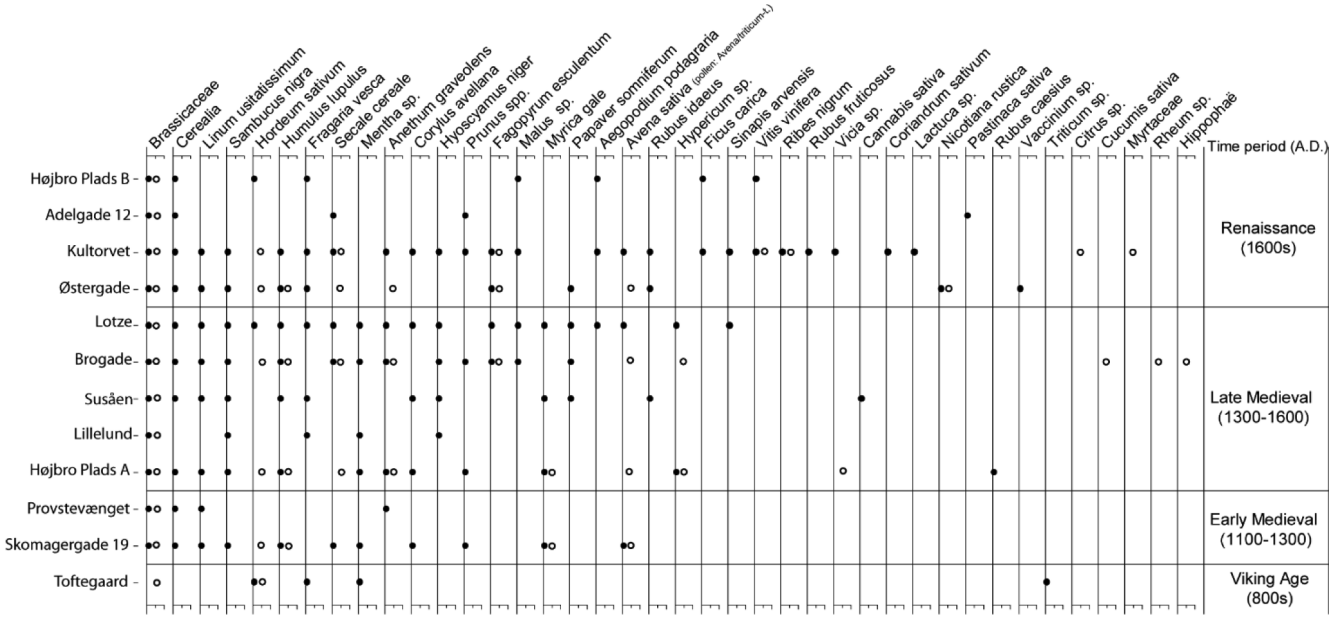

Fig. 2. Food plants present in the latrines, ● = macroscopic plant remains and o = pollen. Taxa are ranked according to the number of samples they appear in, starting with most frequent taxa to the left. While shells of nuts are listed here, pollen of nut trees have not been included in the list, as we believe they are more likely to represent a general "background noise" of trees in the city rather than the consumption of nuts.

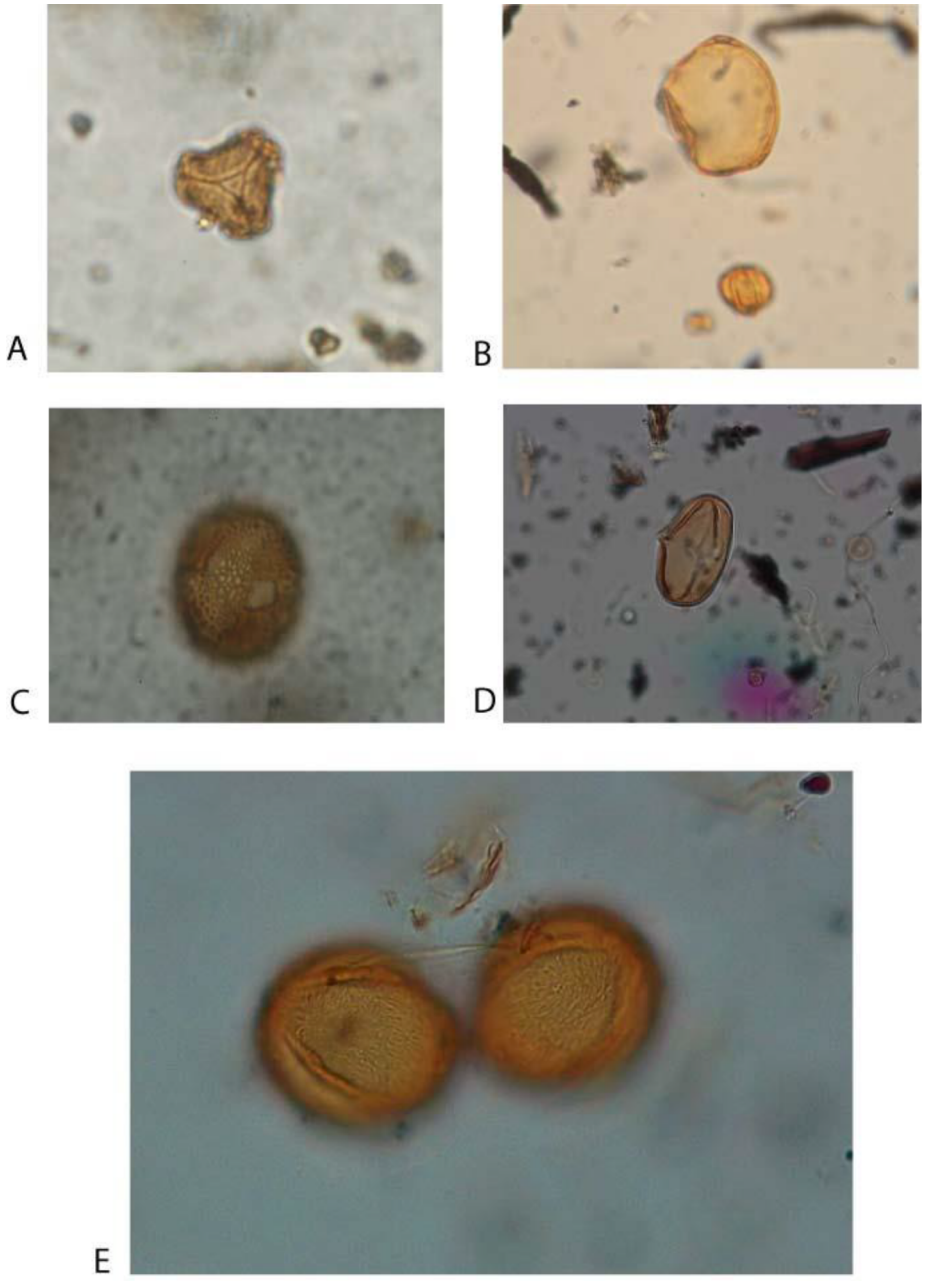

Fig. 3. Pollen of A: Myrtaceae (*Syzygium aromaticum*) 1000x; B: *Cucumis sativus* together with *Artemisia* 630x; C: *Citrus limon/aurantium* 1000x; D: *Rheum* 630x; E: *Nicotiana* 630x.

not earlier been observed in Denmark, including cucumber and rhubarb, both found at Brogade, and presented here for the first time. The cucumber pollen are triporate and oblate, 43 μm, and the most obvious identification is that of *Cucumis sativus*, which is able to grow outdoors in Denmark unlike for instance melon (*Cucumis melo*). Rhubarb pollen are tricolporate, finely reticulate, with transversal furrow, 33 × 19μm. *Rheum rhabarberum* is the most likely candidate.

Pollen of citrus and cloves were found at Kultorvet and first presented in Hald et al., 2018. The clove pollen, actually a Myrtaceae pollen, is tricolporate, psilate, 14–16 μm, and pollen of Myrtaceae in the context of latrines are normally interpreted as cloves, *Syzygium aromaticum* (Deforce, 2005, 2010). The Citrus pollen are stephanocolporate, reticulate with four colpi and pores, 35 μm. Comparison with our modern reference collection shows the highest resemblance with *Citrus limon* and *C. aurantium.*

Tobacco pollen, observed at Østergade, are tricolporate, striate with short valla, 32 μm (Beug, 2004). *Nicotiana rustica* is the most likely species as it is also found as a seed in the sample. Tobacco has previously been observed in a slightly later latrine from Copenhagen (Andersen and Moltsen, 2007).

Animal bones representative of food can be divided into two categories: bones that were consumed as part of a meal, and bones that were brought into the household with meat but disposed of either while preparing, or after consuming, the meal. In the first category, small fish bones such as those from herring are usually consumed with the fish meat and will pass through the digestive tract, whereas larger bones such as those from cattle or pigs belong in the second category. As with the plant remains, there are certain caveats to keep in mind regarding potential biases in the bone assemblage: The fact that fish, especially herring, bones were regularly consumed as part of the meal and that

other small fish bones were likely to have been disposed of along with remains of meals, may very likely generate a bias towards fish bone contra other animal bones in the latrine deposits. Larger bones of sheep and cattle are less likely to have arrived on the dinner table, and may have been disposed of in a different manner, i.e. thrown out in a pile of household waste rather than in the latrines. The meals we are looking at here may, therefore, have included a larger proportion of meat other than fish than can be gleaned from the contents of the latrines.

The animal bones observed in the latrines (Table 4) are predominantly fish bones, and of those, bones of herring (*Clupea harengus*) and cod (*Gadus morhua*) form the largest individual species group. Bones of eel (*Anguilla anguilla)*, haddock (*Melanogrammus aeglefinus)* and plaice/flounder/dab (*Pleuronectes platessa/P. flesus/Limanda limanda)* were also observed. As mentioned above, herring bones are usually consumed with the whole fish, and we can assume that the herring bones were components of faeces in the latrine. The other fish bones, on the other hand, are likely to have been leftovers of meals, or from the preparation of meals. Etching of fish bones may happen after consumption as the bones go through the human digestive gut (Nicholson, 1993), but none of the fish bones showed evidence for this. Cut marks from preparing the fish for meals were observed on two of the cod bones. For both herring and cod, all elements of the skeleton were present, indicating that whole fish were brought to the household and prepared for meals. From flatfish, on the other hand, only bones from the heads were found, i.e. the leftovers from preparing the fish for consumption as for instance fish filets, where the remaining body parts must have been disposed of elsewhere.

Pig (*Sus domesticus*) bones are found in three of the latrines, while those of cattle (*Bos taurus*), sheep (*Ovis aries*) and sheep/goat (*Ovis aries/Capra hircus*) were each found in one latrine. Cut marks were observed on bones from all of these species, which were clearly intended for consumption. Birds are represented by the finds of pigeon (*Columba livia/C. domestica)* and Greylag/domestic goose (*Anser anser/A. domesticus)*. Both of the bird species are very meaty and are likely to have been on the menu.

3.2. Non-food remains

The non-food plant remains observed in the latrines were divided into groups of field weeds, ruderals, wild taxa and trees (Table 3 and Supplementary table). Among the field weeds, Fat-hen (*Chenopodium album*), Field Penny-cress (*Thlaspi arvense*) and Corncockle (*Agrostemma githago*) dominate with a presence in 11 out of 12 latrines, while the most common ruderal is Sheep's Sorrel (*Rumex acetosella*), present in 10 latrines. The non-food flora is likely to have arrived in the latrines as discarded by-products from processing crops and preparing meals, and a general "background noise" of trees, weeds and ruderals growing in the vicinity of the latrines. Straw, represented by cereal pollen, may have been used as both floor covering around the latrine, and for "ventilating" the latrines to drain off liquids and reduce the smell. During excavation of the Kultorvet latrine large amounts of straw were still visible, perfectly preserved, on top of the fecal deposits in the barrels (Hald et al., 2018: 603).

Animal bones that are not considered food remains include the bones of a kitten from Kultorvet as well as two cats and an almost complete skeleton of a dog the size of a "rat dog" from Højbro Plads A. We presume that these animals were disposed of as rubbish after death.

Further discussion of the non-food aspect of the latrine contents is beyond the scope of this paper; however, it shows that latrines were not always used only as such, but were also commonly used for the disposal of general household refuse. This has implications for the interpretation of the food remains as well; as has earlier been highlighted with the Kultorvet latrine, for instance, buckwheat (*Fagopyrum esculentum*) husks were here interpreted as packaging material for Dutch imported goods rather than by-products of food processing, thus serving a distinctly non-culinary purpose (Hald et al., 2018: 609).

4. Discussion

The latrines discussed here provide glimpses of ingredients that were used in meals over a 900-year time span. The fluctuations of these ingredients – the arrival of some, the disappearance of others – tell a story not only of food choices, but are also reflections of wider socio-political developments over time.

4.1. Food remains in the latrines: culinary practices, trade and the Bavarian Purity Law

From the results of our analyses, it is clear that while many types of food appear to have been consumed quite regularly in eastern Denmark over the 900 years covered by the present study, some food items are first introduced in later periods, and others disappear over time.

Brassicaceae and cereals are present throughout. From the latter, we may safely assume that bread, gruel or porridge formed a substantial component of the daily meals. The Brassicaceae, mainly insect-pollinated plants, very likely represent remains of honey, and some of the seeds that have been identified to species, show that we have remains of mustard (*Brassica nigra*) as well. Though they have not been identified as such, it is also very likely that some of the Brassicaeae represent cabbage (*B. oleraceae*), which we know historically have formed a major component of meals in the past. From written sources dating back to at least the 13th century (including the Law of Jutland from 1241) we know that cabbage gardens were a highly valued feature within households, and that theft of cabbage was considered a serious crime. A 1377 gazetteer of houses and landholdings in Copenhagen shows that almost every single household had its own cabbage plot (Kjersgaard, 1978:35). Any cabbage that may have been in the latrines most likely came from plots like these within the cities or settlements, while cereals would have arrived from the surrounding countryside.

The bone assemblage shows the continued predominance of fish in the diet, from Højbro Plads A in the 1400s to Kultorvet in the late 1600s, both in central Copenhagen. In the Højbro Plads A latrine, cod and codfish are the most common species, while in the Kultorvet latrine the most dominant species is herring. Herring fishing in the Øresund Strait between Denmark and Sweden was substantial during medieval times. Most likely the herring we see in the Copenhagen latrines would have been caught there. The herring were caught in trawls or nets at deeper sea levels, potentially with the haddock and cod as a bycatch. Flatfish and the inshore stationary populations of cod would have been caught near the coast either in fish traps or by hook and line. There does not seem to have been a wide variety of fish available for Copenhageners to buy; from Kultorvet, five fish species were identified, and despite nearly four times as many fish bones being analysed from Højbro Plads A, only four fish species were identified from this latrine. Here, the codfish are all about 40–45 cm in total length while the herring and flatfish are about 30 cm in total length, both well above the minimum size requirements of modern fish (respectively, 30–35 cm and 25–27 cm) caught for consumption, as laid out by the Danish Fisheries Agency.

A wide range of fruit, berries, vegetables and herbs are found in the latrines, showing that fresh produce was available on the table throughout the periods covered here. Most of this produce, such as plums, apples, raspberries, blackcurrants, cucumber and figs, could be preserved as dried fruit, pickles or jams and thus be available for consumption all year round, meaning that an approximation of a seasonal use of the latrines is not possible. Apart from citrus (*Citrus* sp.), which will be discussed in further detail below, all the fruit, berries, vegetables and herbs could have been grown locally, though fig is probably as likely to have been imported as home-grown. The fig trade between the Mediterranean region and northern Europe was substantial from the 1200s onwards, figs being used as a meat substitute on Catholic fasting days (Jahnke, 2016).

Two of the vegetables observed in the c. 1500 Brogade latrine in

Svendborg, cucumber and rhubarb, form the first archaeological finds of these vegetables in Denmark. They are both present as pollen. As the stems of rhubarb are eaten before the plant produces seeds, rhubarb seeds are not likely to be found in archaeological deposits. Cucumber is usually eaten with the seeds, which are immature and fragile. The seeds are crushed in the process of consumption and are therefore unlikely to be found archaeologically, or if found, identified to species. The finds of pollen of these two vegetables, therefore, underlines the advantage of combining the analysis of grains/seeds with that of pollen in the investigation of this type of archaeological deposit. Cucumber is generally thought to have arrived in Denmark in the 1600s, but here we have evidence for its presence some 100 years earlier. Rhubarb, which was only used medicinally (and purchased from the apothecary) until the end of the 1800s (Brøndegaard, 1978), is generally thought not to have arrived in Denmark until the early 1800s, though it is mentioned in a Danish medical book from c. 1450 (Lange, 1959:427-29). With the rhubarb pollen from the Brogade latrine, we now have definite evidence for the presence of rhubarb in Denmark by c. 1500, though it cannot be ascertained whether its use was medicinal or culinary.

A number of plants reflect contacts with the wider world. Tobacco was found as both seed and pollen in the Østergade latrine in Hillerød from the first half of the 1600s. It is the species *Nicotiana rustica* which is able to grow in Denmark, and may here have been used as chewing tobacco. Though likely to have been home-grown, this find of tobacco nevertheless bears witness to contacts with the outside world, here specifically with the New World colonies. An earlier study of a latrine in Copenhagen, dated to the early 1700s (Andersen and Moltsen, 2007) also contained tobacco. The plant arrived in Denmark in the first half of the 1600s from further south in Europe, and the habit of chewing/smoking caught on quite fast (Brøndegaard, 1978: 38-40).

Other exotic plants include grape found in the Kultorvet and Højbro Plads B latrines, both from late 1600s-early 1700s Copenhagen, as well as citrus and cloves, found only at Kultorvet (Hald et al., 2018). Grape pollen have been observed from the Early Neolithic in Denmark (Troels-Smith et al., 2018), while grape seeds are seen from the Iron Age (Henriksen et al., 2017). Citrus could potentially have been grown locally in greenhouses (though only just established in Denmark around this time and therefore very rare). However, we suggest that both plants are more likely to have been imported from the Mediterranean region as raisins and dried peels, respectively. Further away, cloves only grew on the Moluccans in Indonesia, which at the time was a Dutch trading colony, providing us with evidence for a clear exotic. Along with many other Dutch imports – white-blue tiles, architecture, coins and clay pipes – cloves have now been added to the list of goods that arrived in Denmark within the realms of the global trading network that had been established at this time.

As mentioned above, bog myrtle is one of the few culinary plants that are restricted to the earlier, rather than the later, latrines; it is found from 1100s Skomagergade in Roskilde up to Late Medieval Lotze's Have in Odense. Bog myrtle was a common ingredient used in the production of beer from the 10th century onwards, appreciated both for its taste and anti-bacterial properties (Behre, 1999). A tenth-century find of mash from the production of beer in Viborg included pollen of bog myrtle (Christensen and Mortensen, 2005). Its disappearance is likely due to geographically wide-ranging changes in beer production introduced with the "Reinheitsgebot" or Bavarian Purity Law in 1516, which ruled that only certain ingredients – barley malt, hops, yeast and water – were to be included in the brewing process (Narziss, 1984:351). Seeds and pollen of hops are consistently present in our assemblage of latrines, from the 1100s to the late 1600s, and are still used in the production of beer today. Like the presence of exotic plants in the latrines, the disappearance of bog myrtle appears to be a reflection of impulses from the outside world, which resulted in changes on the dinner table.

4.2. Regional and social food consumption patterns

The assemblage of latrines allows us to look not only at differences in culinary practices over time, but also, to some degree, to explore whether patterns of consumption are related to social or geographical variables. Social class is here determined from the type of household that the latrine is associated with, which again has been determined by the excavators from architectural remains and material culture found in the vicinity of the latrine. The social class designation for each latrine is listed in Table 1, and as can be seen, most of the latrines are found in households that are considered middle class to high-status. The only exception is the latrine from Lotzes Have in Odense, which may have been used by the servants of a household only. Distinguishing between the "upstairs" and "downstairs" of a household exclusively on consumption patterns is problematic, as the same overall food items brought to the household kitchen will be eaten by both the family of the house and its servants, and any leftovers of meals prepared exclusively for the family could potentially have been passed on to the kitchen staff. Even so, we can observe that while the latrine at Lotzes Have contains more or less the full range of common plant crops that are also found in the other latrines, there are no finds of exotics or any of the slightly less common food plants that almost every other latrine contains at least a few items of. Importantly, pollen analysis, which has provided evidence for some of the rarer plants in the assemblage, was not carried out for the Lotzes Have latrine, and this may account for the lack of exotics or rarer plants. However, it could also mean that the Lotzes Have assemblage may be a reflection of its use by servants who had access to the everyday meals of the household kitchen, but meals containing exotic ingredients were either not made at all in this household, or not passed on to the kitchen staff.

A number of food plants are only present in latrines connected with what appears to be quite well-to-do tradespeople; fig and grape, for instance, are only present in the 16–1700s Copenhagen latrines at Kultorvet and Højbro Plads B, and the Kultorvet latrine is the only one containing exotic spices such as citrus and cloves (Hald et al., 2018). While citrus and clove have not been found previously in Denmark, fig and grape have been observed earlier, usually in quite high-status contexts: They were both present in a Copenhagen latrine (Andersen and Moltsen, 2007) from the early 1700s, associated with one of the finest restaurants in the city at the time (Andersen and Moltsen, 2007: 253), as well as in a contemporary latrine from the household of the bishop of Aalborg (Ørnbjerg et al., 2016).

The animal bones in the assemblage are somewhat inconclusive when it comes to indications of social class. The bias towards fish bones in the assemblage, as discussed in Section 3.1, means that traditionally "high-status meat" from large animals such as cattle and pigs are probably underrepresented. Fish are not useful as status indicators either, as most cities in Denmark are placed along the coast or fjords and access to its resources are, therefore, relatively easy – a popular fish such as cod could be caught by hook and line by the harbour front (Brøndegaard, 1985:252).

There are a few indications of regional differences in food preferences: Buckwheat, which was never a very important crop in Denmark, makes its earliest appearance on the island of Funen, where it traditionally has been the most common. We find it at Late Medieval Brogade in Svendborg and Lotzes Have in Odense. As mentioned above, the presence of buckwheat in the Kultorvet latrine in Copenhagen may not be related to the consumption of this crop, however, we also find evidence of buckwheat in the Østergade latrine from Hillerød, indicating that by the early 1600s this crop may also have been grown on Zealand. It is also at Funen – again, at Late Medieval Brogade – that we have found the first evidence for cucumber and rhubarb.

5. Conclusions

This is the first comprehensive study of the organic contents of a large assemblage of ancient latrines in Denmark, enabling the identification of components of meals through a 900-year period, from the Viking Age to the Renaissance. From the remains of plants and animal bones it has been possible to make a record of the food staples through this period, as well as tracing the arrival of new types of food items over time.

The combined analysis of macroscopic plant remains and pollen have shown that this method significantly increases the range of plant taxa observed in the samples. Our study has provided evidence for the presence of cucumber, rhubarb, citrus, and cloves, which had not previously been observed archaeologically in Denmark. We have also shown how the arrival, as well as disappearance, of certain food types relates to impulses from the wider world, including the introduction of new laws on beer brewing, the colonization of the New World, and the global trade networks, that made an impact on meals in Denmark in the past.

CRediT authorship contribution statement

Mette Marie Hald: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing, Project administration, Funding acquisition. **Betina Magnussen:** Formal analysis, Investigation, Writing - original draft, Writing - review & editing. **Liv Appel:** Resources, Writing - review & editing. **Jakob Tue Christensen:** Resources, Writing - review & editing. **Camilla Haarby Hansen:** Resources, Writing - review & editing. **Peter Steen Henriksen:** Formal analysis, Investigation, Writing - review & editing. **Jesper Langkilde:** Resources, Writing - review & editing. **Kristoffer Buck Pedersen:** Resources, Writing - review & editing. **Allan Dørup Knudsen:** Resources, Writing - review & editing. **Morten Fischer Mortensen:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing.

Acknowledgements

This paper was written during the undertaking of the research project “Medieval Meals” funded by the Danish Ministry of Culture’s Research Committee (FPK.2016-0046). The Committee was not involved in any aspect of the research project. The authors would like to thank Bas van Geel, University of Amsterdam, and Koen Deforce, Royal Belgian Institute of Natural Sciences, for advice on aspects of the pollen analysis, as well as Carsten Jahnke, University of Copenhagen, for information regarding trade in food plants in the Middle Ages. The authors would also like to thank the two anonymous reviewers for their insightful comments.

Appendix A. Supplementary table

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jasrep.2020.102361.

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